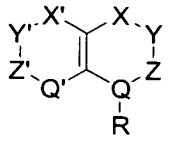
WHAT IS CLAIMED IS:

1. A chiral nanotube, comprising a plurality of a nanotube monomers, where the nanotube monomers are arranged into a plurality of rings, each formed by hydrogen bonding between the nanotube monomers; where the rings are stacked, thereby forming a tube; and where at least a portion of the nanotube monomers include a covalently linked synthetic receptor.

2. The nanotube of claim 1, wherein each nanotube monomer is a compound having a formula selected from the group consisting of:



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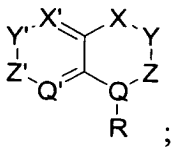


;

wherein:

X, X', Y, and Y' are each independently selected from the group consisting of hydrogen bond donors and hydrogen bond acceptors;

Z is an hydrogen bond donor, an hydrogen bond acceptor, or Z represents a single or a double bond connecting Y and Q;

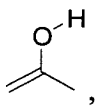
Z' is an hydrogen bond donor, an hydrogen bond acceptor, or Z' represents a single or a double bond connecting Y' and Q';

Q and Q' are each independently selected from the group consisting of -N-, -NH-, =N-, -CH-, -CH_2-, and =CH-; and

R is a synthetic receptor, or a derivative thereof;

providing that when X is an hydrogen bond donor, X' is an hydrogen bond acceptor; when X is an hydrogen bond acceptor, X' is an hydrogen bond donor; when Y is an hydrogen bond donor, Y' is an hydrogen bond acceptor; when Y is an hydrogen bond acceptor, Y' is an hydrogen bond donor; when Z is an hydrogen bond donor, Z' is an hydrogen bond acceptor; and when Z is an hydrogen bond acceptor, Z' is an hydrogen bond donor.

3. The nanotube of claim 2, wherein the hydrogen bond donor is a divalent radical having a formula selected from the group consisting of:



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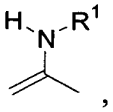


,
and


,

where R^1 is hydrogen or alkyl; and

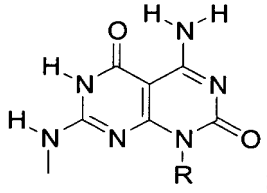
the hydrogen bond acceptor is a divalent radical having a formula selected from the group consisting of:

 and  .

4. The nanotube of claim 1, wherein the synthetic receptor is a radical having the formula $-(CH_2)_n-R'$, where n is an integer selected from the group consisting of 2, 3, 4, and 5; and R' is selected from the group consisting of crown ethers, cryptands, cyclodextrins, amino acids, peptides, diamines, triamines, and derivatives thereof.

5. The nanotube of claim 4, wherein R' is selected from the group consisting of aminobenzo-18-crown-6, lysine, and 1,5-diaminopentane.

6. The nanotube of claim 1, wherein each nanotube monomer is a compound having the formula:

 ; and

R is a synthetic receptor, or a derivative thereof.

7. A chiral nanotube comprising:

a plurality of nanotube monomers, each having a synthetic receptor; and

a plurality of chiral promoters, where the chiral promoters are bound to the synthetic receptors.

8. The nanotube of claim 7, wherein the plurality of chiral promoters is selected from the group consisting of amines and amino acids.

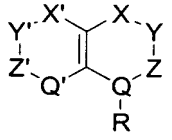
9. The nanotube of claim 7, wherein the plurality of chiral promoters is selected from the group consisting of amines and amino acids having a primary amine functionality.

10. The nanotube of claim 7, wherein the plurality of chiral promoters are alpha amino acids, where the alpha amino acids are substituted with alkyl, optionally-substituted aryl, optionally-substituted arylalkyl, thioalkyl, alkylthioalkyl, hydroxyalkyl, alkoxyalkyl, aminoalkyl, alkylaminoalkyl, dialkylaminoalkyl, or a group $-(CH_2)_m-R''$, where m is an integer selected from the group consisting of 1, 2, 3, 4, and 5; R'' is $-CO_2R^2$, $-CONR^3R^4$, or $-NR^5C(NR^6)NR^3R^4$, and R^2, R^3, R^4, R^5, and R^6 are each independently selected from the group consisting of hydrogen, alkyl, and optionally-substituted arylalkyl.

11. The nanotube of claim 7, wherein the plurality of chiral promoters is selected from the group consisting of alanine, leucine, 2-butyl-2-aminoethanoic acid, phenylalanine, 2-(naphth-2-ylmethyl)-2-aminoethanoic acid, methionine, serine, glutamic acid, and glutamine.

12. The nanotube of claim 7, wherein the plurality of chiral promoters is selected from the group consisting of alanine, leucine, phenylalanine, 2-(naphth-2-ylmethyl)-2-aminoethanoic acid, and methionine.

13. The nanotube of claim 7, wherein the plurality of nanotube monomers is selected from the group of compounds consisting:



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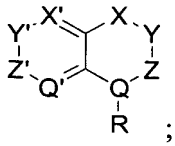


;

wherein:

X, X', Y, and Y' are each independently selected from the group consisting of hydrogen bond donors and hydrogen bond acceptors;

Z is an hydrogen bond donor, an hydrogen bond acceptor, or Z represents a single or a double bond connecting Y and Q;

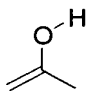
Z' is an hydrogen bond donor, an hydrogen bond acceptor, or Z' represents a single or a double bond connecting Y' and Q';

Q and Q' are each independently selected from the group consisting of -N-, -NH-, =N-, -CH-, -CH_2-, and =CH-; and

R is a synthetic receptor, or a derivative thereof;

providing that when X is an hydrogen bond donor, X' is an hydrogen bond acceptor; when X is an hydrogen bond acceptor, X' is an hydrogen bond donor; when Y is an hydrogen bond donor, Y' is an hydrogen bond acceptor; when Y is an hydrogen bond acceptor, Y' is an hydrogen bond donor; when Z is an hydrogen bond donor, Z' is an hydrogen bond acceptor; and when Z is an hydrogen bond acceptor, Z' is an hydrogen bond donor.

14. The nanotube of claim 13, wherein the hydrogen bond donor is a divalent radical having a formula selected from the group consisting of:



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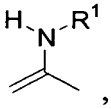

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where R^1 is hydrogen or alkyl; and

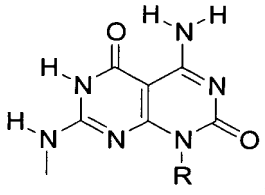
the hydrogen bond acceptor is a divalent radical having a formula selected from the group consisting of:

 and  .

15. The nanotube of claim 13, wherein R is a synthetic receptor having the formula $-(CH_2)_n-R'$, where n is an integer selected from the group consisting of 2, 3, 4, and 5, and R' is selected from the group consisting of crown ethers, cryptands, cyclodextrins, amino acids, peptides, diamines, triamines, and derivatives thereof.

16. The nanotube of claim 15, wherein R' is selected from the group consisting of aminobenzo-18-crown-6, lysine, and 1,5-diaminopentane.

17. The nanotube of claim 7, wherein each nanotube monomer is a compound having the formula:

 ; and

R is the synthetic receptor or a derivative thereof.

18. A process for forming an optically active solution of chiral nanotubes comprising, adding a promoter to a solution of nanotubes where the nanotubes are assembled from nanotube monomers at least a portion of which include a synthetic receptor, in an amount effective to cause an enantiomeric excess of one chiral nanotube.

19. The process of claim 18, wherein the adding step includes adding a solution of the promoter to the solution of nanotubes, where the solution of the promoter is optically active and the solution of nanotubes is a racemic mixture of chiral nanotubes.

20. The process of claim 18, wherein the adding step includes adding the promoter to the solution of nanotubes, where the solution of nanotubes includes a first chiral nanotube and a second chiral nanotube, where the first and second chiral nanotubes have opposite chirality, and the promoter is added in an amount effective to convert at least a portion of the chirality of the first chiral nanotube into the chirality of the second chiral nanotube.

21. A process for forming a dilute solution of chiral nanotubes comprising, adding a promoter to a solution of nanotube monomers in an amount effective to cause the formation of the chiral nanotubes.

22. The process of claim 21, wherein the adding step includes adding a solution of the promoter, where the solution of the promoter is optically active.

23. The process of claim 21, wherein the adding step includes adding an homochiral promoter.

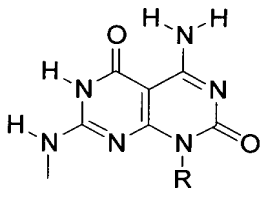
24. A process for stabilizing a solution of nanotubes to dilution comprising:

(a) adding a promoter to a solution of nanotubes in an amount effective to prevent the disassembly of the nanotubes during dilution over a pre-determined range of concentration; and

(b) diluting the solution of nanotubes over the pre-determined range of concentration.

25. The process of claim 24, wherein the adding step includes adding an homochiral promoter to the solution of nanotubes in an amount effective to preferentially prevent the disassembly of the one nanotube enantiomer relative to the other nanotube enantiomer during dilution, thereby stabilizing an optically active dilute solution of chiral nanotubes during dilution.

26. A compound having the formula:



; and

wherein:

R is a radical having the formula $-(CH_2)_n-R'$, where n is an integer selected from the group consisting of 2, 3, 4, and 5; and R' is selected from the group consisting of crown ethers, cryptands, cyclodextrins, peptides, diamines, triamines, and derivatives thereof.

27. The compound of claim 26, wherein R is a radical having the formula $-(CH_2)_n-R'$, where n is an integer selected from the group consisting of 2, 3, 4, and 5; and R' is selected from the group consisting of crown ethers, and derivatives thereof.